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(54) **Use of sericin as antioxidants and tyrosinase inhibitors**

(57) This invention relates to a composition useful as an antioxidant or an inhibitor for tyrosinase activity which comprises as an active ingredient a sufficient amount of sericin to exert an antioxidizing ability or an

inhibiting action on tyrosinase activity and this composition is applicable as an antioxidant or a tyrosinase activity inhibitor in the field of medicines, quasi-drugs, medicines for external use, cosmetics, foods, food additives or the like.

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## Description

## FIELD OF THE INVENTION

5 This invention relates to a novel antioxidant or tyrosinase inhibitor which can be employed in the various fields of , for example , foods, cosmetics, medicines and others. More particularly, this invention relates to a novel antioxidant or tyrosinase inhibitor which comprises as an active ingredient sericin , a protein obtainable from silkworm cocoon or raw silk.

## BACKGROUND OF THE INVENTION

10 Recently, it has been suggested from the researches made in the field of medicine, biochemistry and others that adult diseases or diseases caused from daily life habit such as myocardial infarction, arteriosclerosis, diabetes mellitus, cancer, cerebral apoplexy and the like or cutaneous disorders such as blotch, freckle, pimple, eczema and the like may be at least partly caused from the lipid peroxide produced and accumulated in vivo.

15 In order to solve such problems, there have been hitherto suggested antioxidants obtainable by the extraction of natural products such as plants, marine products, microorganisms and the like or chemically synthesized antioxidants. There have been , for example , utilized as natural antioxidants-vitamin E ( tocopherol ), vitamin C ( L-ascorbic acid ), or a SOD(superoxide dismutase ; one of in vivo enzymes)-like substance. There have been also suggested as synthetic antioxidants phenolic derivatives such as BHA ( butyrate hydroxyanisole ), BHT ( butyrate hydroxytoluene ) and the like.

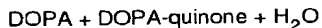
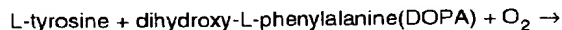
20 However, in the case of natural antioxidants, for instance , SOD has the drawbacks that it is highly expensive owing to difficulty in purification and may be deactivated by heating owing to an enzymatic protein. Although other antioxidative proteins are also found, they all have the similar drawbacks as seen in the SOD. It has been suggested that synthetic antioxidants have problems with regard to safety. In particular, it has been suggested that BHA is a carcinogen. Moreover, when used for foods, many of them have been restricted in the amount to be used or the extent of their usage.

25 Many of the natural and synthetic antioxidants are usually fat-soluble and , in the case of natural antioxidants , vitamin E or  $\beta$ -carotene may possess , for example , a potent in vivo inhibitory effect on lipid peroxide , but it has the problem of a restricted usage extent because of a slight solubility in water. Water-soluble natural antioxidants are restricted in their sort and there may be solely mentioned , for example , vitamin C, glutathione, uric acid, SOD, etc.

30 However, vitamin C and glutathione may act as a pro-oxidant, i.e. , an oxidation promoter in the presence of a metallic ion and have the drawback that they tend to promote the peroxidation of lipid under some conditions. Uric acid is water-soluble, but slightly soluble in water and , when accumulated in vivo , it may be responsible for gout or renal calculus.

35 Moreover, there has been posed the problem that there have been found out few natural water-soluble antioxidants having a high lipid peroxide inhibiting effect comparable to vitamin C.

40 Tyrosinase is one kind of enzyme having the activity of monophenol monooxygenase EC 1. 14. 18. 1. The enzyme of this type is widely distributed in animals, plants and microorganisms , typically melanocyte, house fly, mushroom, potato, apple, Neurospora, etc. Recently, the enzyme of this type has been highly purified from various materials, and , for example , it is purified from the fruit body of mushroom by acetone treatment, ammonium sulfate fractionation, ion exchange or gel filtration. Its molecular weight is 119,000 in the enzyme derived from mushroom, 144,000 in the enzyme derived from higher plants or 33,000 in the enzyme derived from Neurospora, and its molecular weight may considerably vary depending upon its origin. All of these enzymes are of a copper enzyme, but their copper contents may be different. It is specific to such substrates as monophenol or o-diphenol and , in particular , the enzyme derived from animals shows a high activity to DOPA and deeply participates in the first stage of melanin biosynthesis. This may be expressed according to the following reaction scheme:



55 Melanin is a pigment which is distributed in the hair or skin in the case of human beings and responsible for the determination of their coloration. Formation of melanin in the skin is one of human protective functions. Biosynthesis of melanin in animals may proceed as follows: First, when exposed to ultraviolet ray, the tyrosinase in melanosome found in melanocyte is activated and DOPA and DOPA- quinone are in turn biosynthesized as shown in the above reaction scheme. Thereafter, the DOPA-quinone is polycondensed in turn by non-enzymatic oxidation, decarboxylation

and coupling reaction to form melanin. When released from irradiation with ultraviolet light, melanin is separated from the corneum by metabolism in the skin to recover the skin coloration. On the other hand, when stimulated, for example, by exposing a high irradiation of ultraviolet light, the melanin-forming function is locally maintained and the corresponding region of the skin remains blackened to cause pigmentation or blotch.

In the field of foods, for example, when captured crustaceans are dead, the crust of the crustaceans becomes discolored within a short period of time. When fruits and vegetables such as apple, yam or lettuce are peeled or cut, the inner parts thereof become discolored within a short period of time. This phenomenon is caused by the activation of tyrosinase found in the said crustaceans or fruits and vegetables and subsequent formation of melanin as the reaction product.

In order to prevent such pigmentation or blotch in the skin caused by melanin formation, to promote cosmetic bleaching effect or to prevent discoloration of foods, there has been hitherto applied an inhibitory agent for tyrosinase activity to prevent melanin biosynthesis. For example, there have been suggested as a synthetic tyrosinase inhibitor various sulfite salts and as a natural tyrosinase inhibitor kojic acid, placenta extract, vitamin C, cysteine or extracts having an inhibiting function on tyrosinase activity which are derived from plants and the like.

However, there have been proposed some problems of safety to a human body. There is the danger, for instance, that allergic response in a human body may be observed for the sulfites or, when the sulfites are used for crustaceans, formaldehyde may be generated during the storage. Although sodium sulfite or sodium hydrogensulfite is designated as a food additive, the criterion for its usage has been specified and its residue in foods has also been regulated.

In the case of natural tyrosinase inhibitors, for instance, kojic acid is difficult to produce or purify and is therefore expensive. More specifically, a strain capable of producing kojic acid is cultivated, and kojic acid is extracted from cultured broth containing the acid as a main component and then crystallized. On the other hand, it has been observed that some strains capable of producing kojic acid could also produce aflatoxin which has a potent carcinogenic activity, and therefore leads to safety problems. Placenta extract is also difficult to produce or purify and is therefore also expensive.

In the case of vitamin C, the enzymatic oxidation reaction by tyrosinase (as shown in the above reaction scheme) is controlled by the reducing power of the said vitamin itself. Accordingly, ascorbic acid is converted to dehydroascorbic acid and ascorbic acid is decreased with lapse of time so that its inhibitory activity could not be maintained. In the case of cysteine, an inhibitory activity could not be maintained because cysteine itself is oxidized in a similar manner to vitamin C and it has the drawback that it may be discolored to black when oxidized. Extracts derived from plants and others by extraction and having an inhibiting function on tyrosinase activity are difficult to identify for their chemical composition with a low purity. In addition, there is the possibility that the quality of the extract may vary between lots.

Moreover, most of the prior art tyrosinase activity inhibitors are fat-soluble and the water-soluble inhibitors for tyrosinase activity are limited in availability.

## SUMMARY OF THE INVENTION

It is an object of this invention to provide a composition having a high antioxidizing activity and a high inhibiting action on tyrosinase activity, which has a high safety because it originates from natural products, is not deactivated even by heating, can be easily and inexpensively produced or purified and is water-soluble in a single, high purity.

According to this invention, there is provided a composition useful as an antioxidant and a tyrosinase activity inhibitor which comprises as an active ingredient a sufficient amount of sericin to exert an antioxidizing ability and an inhibiting action on tyrosinase activity.

## DETAILED DESCRIPTION OF THE INVENTION

As the sericin which may be employed in this invention, there may be preferably used sericin which has a high purity and is usually derived from silkworm cocoon or raw silk and includes its hydrolyzate.

The sericin which may be employed in this invention may be obtained from silkworm cocoon or raw silk according to a conventional extraction method. For instance, it may be extracted in the form of a single protein with a 90% or higher purity according to the following procedure.

That is to say, the sericin contained in silkworm cocoon or raw silk is extracted with water and then subjected to, for example, the procedure (1), (2) or (3) detailed below to give a sericin.

Alternatively, the sericin hydrolyzate which may be employed in this invention may be obtained from silkworm cocoon or raw silk according to a conventional extraction method. For instance, it may be extracted in the form of a single protein (a peptide) with a 90% or higher purity according to the following procedure.

That is to say, the sericin contained in silkworm cocoon or raw silk is extracted and partially hydrolyzed with an acid, an alkali or an enzyme and then subjected to, for example, the following procedure (1), (2) or (3) to give a sericin hydrolyzate.

(1) An aqueous solution of sericin is adjusted to pH 3 ~ 5 with an organic acid or an inorganic acid, an organic coagulating agent or an inorganic coagulating agent to separate out sericin, which is then filtered and dried to give a solid sericin.

(2) An aqueous solution of sericin is admixed with a water-miscible solvent such as methanol, ethanol or dioxane to separate out sericin, which is then filtered and dried to give a solid sericin.

(3) An aqueous solution of sericin is passed through a dialysis membrane to remove the substance passed through the membrane and then the substance left on the membrane is dried to give a solid sericin.

The free sericin base or sericin hydrolyzate obtained as described above may be used in any suitable form, for example, in the form of its solid as it stands or in the form of a solution dissolved in a solvent, preferably an aqueous solution dissolved in a proper volume of water, in compliance with the intended use as an antioxidant or a tyrosinase activity inhibitor.

The sericin or its hydrolyzate may be utilized for cosmetics, foods, food additives, medicines for external use, quasi-drugs, medicines, etc. similarly to the antioxidants or tyrosinase activity inhibitors of the prior art.

An amount of the sericin to be blended is usually about 0.1 ~ 50% by weight, preferably about 0.5 ~ 5% by weight, for example, in cosmetics, food additives, medicines for external use, quasi-drugs and the like. An amount of the sericin to be blended is usually about 0.1 ~ 100% by weight, preferably about 0.5 ~ 50% by weight in foods. As sericin has no toxicity and a superior solubility in water, there would not be posed any specific problem even if a large amount thereof may be blended or taken.

A dosage form of cosmetics or medicines for external use may include, for example, creams, emulsions, foundations, packs, lotions, gel-, solution- or stick-like dosage forms and the like. These dosage forms may be optionally blended with any suitable components conventionally used in the corresponding fields, such as lubricants, humectants, thickening agents, preservatives, emulsifying agents, pigments, pH adjustors, other active components, ultraviolet absorbers, perfumes, etc.

The sericin or its hydrolyzate may be orally administered as medicines. In this instance, a dose is not particularly critical and it may be administered, for example, at a dose of about 10mg ~ 100g/day.

As an alternative embodiment of this invention, there may be concomitantly used with sericin or its hydrolyzate in the composition of this invention any other active components or additive components which are conventionally added to the prior art antioxidants or tyrosinase activity inhibitors. These components are not particularly critical and may be optionally incorporated, in addition to the main active ingredient, i.e., sericin or its hydrolyzate.

Representative examples of these components which may be concomitantly employed in the field of foods for the favorable results will be recited hereinbelow.

Discoloration inhibitors: Polyphosphoric acid or salts thereof, metaphosphoric acid or salts thereof, pyrophosphoric acid or salts thereof, citric acid or salts thereof, potassium aluminum sulfate, erythorbic acid or salts thereof and the like.

Antimicrobial agents and preservatives: benzoic acid or salts thereof, orthophenylphenol or salts thereof, diphenyl, sorbic acid or salts thereof, thiabendazole, dehydroacetic acid or salts thereof, paraoxybenzoic acid alkyl esters, propionic acid or salts thereof, bleaching powder, hypochlorous acid or salts thereof, fumaric acid,  $\epsilon$ -polylysine, glycine, lysozyme, anise extract and the like.

Representative examples of these components which may be Representative examples of these components which may be concomitantly employed in the field of cosmetics for the favorable results will be recited hereinbelow.

Astringents: citric acid or salts thereof, tartaric acid or salts thereof, lactic acid or salts thereof, aluminum chloride, potassium aluminum sulfate and the like.

Antimicrobial agents and preservatives: Benzoic acid, sodium benzoate, paraoxybenzoic acid esters, distearyl-methylammonium chloride, benzethonium chloride, alkyldiaminoethylglycine chloride solutions, chlorhexidine dihydrochloride, orthophenylphenol, sensitizing dye No. 101, sensitizing dye No. 201, salicylic acid, sodium salicylate, sorbic acid, halocarbon, resorcin, parachlorophenol, phenoxyethanol and the like.

Cosmetic bleaching agents: Ascorbic acid and derivatives thereof, sulfur, placenta extract, kojic acid and derivatives thereof, glucosamine and derivatives thereof, azelaic acid and derivatives thereof, arbutin and derivatives thereof, hydroxycinnamic acid and derivatives thereof, glutathione and the like.

Ultraviolet absorbers:  $\beta$ -Isopropylfuranone derivatives, urocanic acid, ethyl urocanate, oxybenzone, oxybenzoesulfonic acid, tetrahydrobenzophenone, dihydroxydimethoxybenzophenone and the like.

Humectants: Glycine, threonine, alanine, collagen, hydrolyzed collagen, vitronectin, fibronectin, keratin, elastin, royal jelly, chondroitin heparin and the like.

Cell activators: Riboflavin or derivatives thereof, pyridoxine or derivatives thereof, nicotinic acid or derivatives thereof, pantothenic acid or derivatives thereof.

Anti-inflammatory agents and anti-allergic agents: azulene, allantoin, aminocaproic acid, indomethacin, lysozyme hydrochloride,  $\epsilon$ -aminocaproic acid, the like.

Fats and oils: soybean oil, linseed oil, tung oil, sesame oil and the like.

Hydrocarbons : Liquid paraffin, Vaseline, microcrystalline wax and the like.

Aliphatic acids : stearic acid, linoleic acid, lauric acid, myristic acid, palmitic acid and the like.

Alcohols : Lauryl alcohol, cetyl alcohol, stearyl alcohol, lanolin alcohol, hydrogenated lanolin alcohol, oleyl alcohol and the like.

Esters : Decyl oleate, butyl stearate, myristyl myristate, hexyl laurate, isopropyl palmitate and the like.

Surfactants : Anionic surfactants, cationic surfactants, amphoteric surfactants, nonionic surfactants.

Perfumes : Menthol, carvone, eugenol, anethole, peppermint oil, spearmint oil and the like.

## DESCRIPTION OF SPECIFIC PREFERRED EMBODIMENTS

The invention will now be described with reference to the following examples:

### Example 1

1kg of silk cloth composed of raw silk was treated in 50L of water at 95°C for 2 hours to extract sericin. The resulting extract was filtered through a filter having an average pore diameter of 0.2µm, the aggregate was removed and the filtrate was desalted through a reverse osmotic membrane to afford a colorless, clear solution of sericin in water with a concentration of 0.2%. This aqueous solution was water with a concentration of 0.2%. This aqueous solution was concentrated by means of an evaporator to a sericin concentration of about 2% and then freeze-dried to afford 100g of a powdery sericin (hereinafter referred to as Sericin H ) having a purity of 95% or higher and an average molecular weight of 100,000.

### Example 2

1kg of silk cloth composed of raw silk was treated in 50L of a 0.2% aqueous solution of sodium carbonate(pH 11 ~ 12) at 95°C for 2 hours to extract a sericin hydrolyzate. The resulting extract was filtered through a filter having an average pore diameter of 0.2µ m, the aggregate was removed and the filtrate was desalted through a reverse osmotic membrane to afford a colorless, clear solution of a sericin hydrolyzate in water with a concentration of 0.2%. This extract was concentrated by means of an evaporator to a sericin concentration of about 2% and then freeze-dried to afford 100g of a powdery sericin hydrolyzate ( hereinafter referred to as Sericin L ) having a purity of 90% or higher and an average molecular weight of 20,000.

### Test Example 1

#### (1) Preparation of rat brain homogenate

To 1g of the rat brain stored under refrigeration was added 9ml of 0.075M phosphate buffer (pH 7.5) and the mixture was homogenated under ice-cooling (hereinafter referred to as homogenate).

#### (2) Inhibitory test of in vivo lipid peroxide

To 0.5ml of the homogenate obtained above was added 3.5ml each of 0.075M phosphate buffers containing Sericin L and Sericin H (pH 7.5), respectively. Incubation was continued at 37°C for 2 hours. At the end of this time, the respective final concentrations of sericin were made to 0.02 ~ 0.5%. Immediately before the incubation and after the incubation for 2 hours, 0.5ml each of the samples was recovered and then TBARS(thiobarbituric acid reactive substance), an indicator of lipid peroxide level , was determined according to the TBA(thiobarbituric acid) method. Antioxidizing ability of sericin was calculated from the TBARS amount obtained when no sericin was added and the TBARS amount obtained when sericin was added according to the following equation 1 and expressed in terms of an inhibitory rate on an increase in lipid peroxide by incubation. In all cases of this Test Example and the following Test Examples 2 ~ 5, tests were repeated three times and the results were shown with an average value of the numerical values thus obtained.

$$\text{Equation 1} \quad \text{Inhibitory rate(\%)} = (1 - A/B) \times 100$$

A : Increased TBARS amount obtained when a lipid peroxide inhibitory agent ( an antioxidant ) was added

B : Increased TBARS amount obtained when no lipid peroxide inhibitory agent ( an antioxidant ) was added

## TBA method

To 0.5ml of a sample were added 2.5ml of a 8% trichloroacetic acid solution and 2.0ml of a 0.67% thiobarbituric acid solution and the resulting mixture was thoroughly mixed and then heated in a boiling water bath for 15 minutes. Thereafter, the mixture was centrifuged at 2000Xg for 10 minutes and the supernatant was measured for absorbance at 535nm to determine a TBARS amount. 1,1,3,3-Tetraethoxypropane was used as a standard.

Table 1

Concentration(%)	Inhibitory rate(%)	
	Sericin L	Sericin H
0.02	9	12
0.05	18	27
0.1	55	20
0.3	100	54
0.5	95	95

As shown in Table 1, it has been established that both Sericin L and Sericin H possess an antioxidizing ability. It has been established that a sericin having any molecular weight may possess an antioxidizing ability.

## Test Example 2

## (1) Preparation of rat brain homogenate

Preparation was carried out in the same manner as described in Test Example 1.

(2) Inhibitory test of in vivo lipid peroxide

To 0.5ml of the homogenate obtained above was added 3.5ml each of 0.075M phosphate buffers (pH 7.5) containing Sericin L, ascorbic acid ( vitamin C ) and bovine serum albumin, respectively. Incubation was continued at 37°C for 2 hours. The final concentrations of Sericin L, ascorbic acid and albumin were made to 0.01% ~ 1.0%. After incubation, a TBARS amount was determined according to the TBA method, similarly to Test Example 1 and inhibitory rates on an increase in lipid peroxide were determined, respectively.

Table 2

Concentration(%)	Sericin L	Ascorbic acid	Albumin
0.01	3	-39	-6
0.05	13	39	-4
0.1	86	87	-12
0.5	96	97	20
1.0	97	96	30

As shown in Table 2, it has been confirmed that a level of an antioxidizing ability of sericin is comparable to that of vitamin C which has been said to have a potent antioxidizing ability. Moreover, it was found the drawback in the case of vitamin C that oxidation may be accelerated in a low concentration range of 0.01%, whereas such a phenomenon was not observed in the case of sericin.

## Test Example 3

## (1) Preparation of rat brain homogenate

Preparation was carried out in the same manner as described in Test Example 1.

(2) Inhibitory test of in vivo lipid peroxide

To 0.5ml of the homogenate obtained above was added 3.5ml each of 0.075M phosphate buffers containing Sericin

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L and Sericin H (pH 7.5), respectively. Incubation was continued at 37°C for 2 hours. Separately, to 0.5ml of the homogenate obtained above was added 3.5ml of 0.075M phosphate buffers containing Sericin L and Sericin H (pH 7.5), which had been previously heated in a boiling water bath for 2 hours, and incubation was continued at 37°C for 2 hours. At the end of this time, the final concentration of sericin was made to 0.5%. A TBARS amount was determined according to the TBA method, similarly to Test Example 1, an inhibitory rate on an increase in lipid peroxide was determined.

Table 3

	Inhibitory rate(%)
0.5% Unheated Sericin L	99
0.5% Heated Sericin L	99
0.5% Unheated Sericin H	85
0.5% Heated Sericin H	78

Even when Sericin L or Sericin H was heated in a boiling water bath for 2 hours and an antioxidizing ability was determined, there was hardly seen a change between said antioxidizing ability and the antioxidizing ability before heating. It has been proved from the results that an antioxidizing ability of sericin could not be inactivated by heating.

### Test Example 4

#### (1) Preparation of rat brain homogenate

Preparation was carried out in the same manner as described in Test Example 1.

#### (2) Inhibitory test of in vivo lipid peroxide

To 0.5ml of the homogenate obtained above was added 3.5ml of 0.075M phosphate buffers (pH 7.5) containing sericin L and incubation was continued at 37°C for 2 hours. The final concentration of sericin L was made to 0.1% or 0.25%. After incubation, 0.5ml of a sample was recovered and 2.5ml of ethyl ether/ethanol (1:3,v/v) was added thereto, and then the resulting mixture was vigorously shaken for one minute. Thereafter, the mixture was centrifuged at 1000Xg for 5 minutes and the upper layer was measured for absorbance at 234nm to give an indicator for an antioxidation amount ( a conjugated diene ). In this Test Example, an antioxidizing ability of sericin was expressed in terms of an inhibitory rate(%) on an increased lipid peroxide.

Table 4

	Inhibitory rate(%)
0.1% Sericin L	80
0.25% Sericin L	86

In Test Examples 1 ~ 3, TBARS was used as an indicator for a lipid peroxide amount, while a conjugated diene was used as an indicator in Test Example 4. It has been also confirmed from these two different indicators that sericin may possess a potent antioxidizing ability.

### Test Example 5

1ml of 100mM carbonate buffer(pH 7.4) containing 160μM arachidonic acid, 150 μM FeCl<sub>3</sub>, 1.0mM sodium ascorbate and 0.3% sericin was incubated at 37°C for one hour. After incubation, 2ml of a mixture of trichloroacetic acid and thiobarbituric acid (containing 15% trichloroacetic acid, 0.375% thiobarbituric acid and 0.25N hydrochloric acid) was added and the mixture was mixed well. Then, 1ml of 0.1% bovine serum albumin was added and the mixture was heated in a boiling water bath for 15 minutes. After centrifugation, the supernatant was measured for absorbance at 535nm to determine a TBARS amount. 1,1,3,3-Tetraethoxypropane was used as a standard. In this Test Example, an antioxidizing ability of sericin was similarly expressed as compared with that of the case where no sericin was added.

Table 5

	Inhibitory rate(%)
0.3% Sericin L	93
0.3% Sericin H	95

Test Examples 1 ~ 4 illustrate the examples using an *in vivo* constituent system, while Test Example 5 illustrates the example wherein a system composed of a pure chemical compound was used as an experimental system. It has been confirmed that sericin could possess an antioxidizing ability even when such different experimental systems were applied.

It has been suggested from the results of Test Examples 4 and 5 that the presence of an antioxidizing ability of sericin is far more reliable, which does not correspond to the phenomenon observed only in the specific experimental system.

#### Test Example 6

To 1/15M phosphate buffer(pH 6.8) containing sericin H or a sericin L were added 0.1 ml of a solution of tyrosinase ( derived from mushroom, manufactured by Sigma Chemical Co.) at 0.5mg/ml ( 1/15M phosphate buffer,pH 6.8) and 0.9ml of 1/15M phosphate buffer(pH 6.8) and the mixture was incubated at 25°C for 10 minutes. Thereafter, 1ml of 0.3mg/ml DOPA ( 1/15M phosphate buffer,pH 6.8) was added, incubation was performed at 25°C for 5 minutes and then absorbance at 475nm(D1) was measured. Separately, a similar procedure was carried out using the enzyme inactivated by heating(D2) to determine an amount of the sericin free DOPA chromium(D3),and then an inhibitory rate was calculated according to the following equation:

$$\text{Inhibitory rate(\%)} = ((D3 - D1)/(D3 - D2)) \times 100$$

As shown in Table 6, it has been confirmed that both of sericin H and sericin L possess an inhibiting ability of tyrosinase activity. In particular, a tyrosinase activity inhibiting ability was ensured to possess at the final concentration of 0.5% or more.

#### Test Example 7

The same experiment as described in Test Example 6 was repeated except that the final concentration of sericin H and sericin L of 0.5% was applied, and the same experiment as above was also repeated for comparison except that bovine serum albumin (the final concentration of 0.5%) was used. Moreover, a solution of sericin or sericin hydrolyzate dissolved in a phosphate buffer was boiled for 2 hours and then a tyrosinase activity inhibiting ability after heating was also determined.

In comparing tyrosinase activity inhibitory rates between sericin H or sericin L and other common proteins( bovine serum albumin), it has been confirmed that bovine serum albumin does hardly possess a tyrosinase activity inhibiting ability and sericin and sericin hydrolyzate are superior to the albumin.

On the other hand, a tyrosinase activity inhibiting ability of sericin H or sericin L remained substantially unchanged even by heating. Accordingly, it has been confirmed that a tyrosinase activity inhibiting ability of sericin or sericin hydrolyzate is considerably stable to heating.

Table 6

Final concentration(%)	Tyrosinase activity		inhibitory rate(%)
	Sericin H	Sericin L	
0.25	6.0	5.3	
0.5	35.5	20.0	
1.0	50.0	29.1	



Table 7

	Final concentration(%)	Tyrosinase activity inhibitory rate(%)
Bovine serum albumin	0.5	5.8
Sericin H (unheated)	0.5	37.5
Sericin H (heated)	0.5	35.0
Sericin L (unheated)	0.5	27.3
Sericin L (heated)	0.5	22.6

Sericin is water-soluble and then may be also employed as an antioxidant or a tyrosinase activity inhibitor for the products having a low content of oils and fats. Moreover, it has no promoting effect of lipid peroxide in a low concentration range as seen in vitamin C.

Furthermore, sericin has the characteristics as seen in the protein or peptide derived from natural products, shows a good affinity with the skin, has no accumulating property because of being easily hydrolyzed by a protease and has a high safety, such that it may be utilized for an extensive field including medicines, quasi-drugs, cosmetics, foods, etc. In addition, it has the characteristics that its activity is not inactivated even by heating and it maintains a prolonged inhibiting activity together with safety.

And further, sericin can be easily extracted from an extract of silkworm cocoon or raw silk with a solvent in a high purity as a single protein or peptide and then it becomes available inexpensively, while its aqueous solution is colorless and transparent so that there is no need for stripping and also for complicated treatment steps, which leads to a great advantage.

#### Claims

1. A composition for use as an antioxidant or an inhibitor for tyrosinase activity which comprises as an active ingredient a sufficient amount of sericin to exert an antioxidizing ability or an inhibitory action on tyrosinase activity.
2. The composition as claimed in Claim 1 wherein it is applied as a medicine, a cosmetic, a discoloration inhibitor, a food additive, a food, or a quasi-drug.
3. The composition as claimed in Claim 2, wherein said cosmetic is a bleaching cosmetic.
4. The composition as claimed in Claim 2, wherein said medicine is a medicine for external use.
5. The composition as claimed in any one of Claims 1 to 4, wherein said sericin is natural sericin extracted from silkworm cocoon or raw silk.
6. The composition as claimed in Claim 1, wherein said sericin is a hydrolyzate of natural sericin.
7. An antioxidant comprising sericin as an active ingredient.
8. An inhibitor for tyrosinase activity comprising sericin as an active ingredient.
9. Use of sericin as an antioxidant.
10. Use of sericin as an inhibitor for tyrosinase activity.
11. A method for the treatment of human skin which comprises applying a sufficient amount of sericin to exert an antioxidizing activity or an inhibiting action on tyrosinase activity.
12. A method for the prevention of discoloration or coloration which comprises adding sericin to a system, the discoloration or coloration of which is to be prevented.

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(54) **Use of sericin as antioxidants and tyrosinase inhibitors**

(57) This invention relates to a composition useful as an antioxidant or an inhibitor for tyrosinase activity which comprises as an active ingredient a sufficient amount of sericin to exert an antioxidizing ability or an

inhibiting action on tyrosinase activity and this composition is applicable as an antioxidant or a tyrosinase activity inhibitor in the field of medicines, quasi-drugs, medicines for external use, cosmetics, foods, food additives or the like.

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European Patent  
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# PARTIAL EUROPEAN SEARCH REPORT

Application Number

which under Rule 45 of the European Patent Convention EP 97 30 8956 shall be considered, for the purposes of subsequent proceedings, as the European search report

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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<b>INCOMPLETE SEARCH</b> <p>The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.</p> <p>Claims searched completely :</p> <p>Claims searched incompletely :</p> <p>Claims not searched :</p> <p>Reason for the limitation of the search:</p> <p>Although claims 10-11 are directed to a method of treatment of the human/animal body (Article 52(4) EPC), the search has been carried out and based on the alleged effects of the compound/composition.</p>			
Place of search		Date of completion of the search	Examiner
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<b>CATEGORY OF CITED DOCUMENTS</b> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons</p> <p>A : member of the same patent family, corresponding document</p>			

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